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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant : Kiyohiko TAKAGI, et al.  
Serial No. : 09/892,023  
Filed : June 26, 2001  
For : DRYING ETCHING METHOD  
Group Art Unit : 2823  
Examiner : William D. Coleman  
Confirmation No : 1827

Certificate of Mailing Under 37 CFR 1.8

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Jacqueline M. Steady  
(Name)

Jacqueline M. Steady  
(Signature)

**APPEAL BRIEF**

MAIL STOP APPEAL BRIEF- PATENTS  
Commissioner for Patents  
P.O. Box 1450, Alexandria, VA 22313-1450

Sir:

This is an appeal from the final rejection of claims 1-4, 6-14 and 16-23 in the Final Office Action of January 21, 2003, the Interview Summary of May 9, 2003, and the facsimile transmission of May 9, 2003 including the Interview

Summary cover page and the "Response After Final Rejection or Advisory Action," sent by the Examiner to Appellant's representatives.

### **REAL PARTY IN INTEREST**

Rights in the present application are assigned to MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD, a corporation existing under the laws of Japan, located at 1006, Oaza Kadoma, Kadoma-shi, Osaka 571-8501, Japan, which is the sole real party in interest.

### **RELATED APPEALS AND INTERFERENCES**

There are no appeals or interferences known to the Appellant or Appellant's legal representatives which will directly affect or be directly affected by or have a bearing on the Board's decision in this pending appeal in the present application.

### **STATUS OF CLAIMS IN THE APPLICATION**

Claims 1-4, 6-14 and 16-23 are pending in this application and are being appealed. No claims have been allowed.

### STATUS OF AMENDMENTS AFTER FINAL ACTION

An Amendment after Final Rejection under 37 CFR 1.116 is filed concurrently herewith. The Amendment merely corrects the dependency of one of the dependent claims and Appellant's representatives assume it will be entered for purposes of Appeal.

### SUMMARY OF THE INVENTION

Referring to Fig. 1, a vacuum chamber 1 is equipped with a gas supply system 2 and a vacuum pump 3 serving as an evacuation system. A substrate 6 to be subjected to etching is placed upon a lower electrode 5 within the vacuum chamber 1. The lower electrode 5 is connected to an RF power source 4. An optical filter 14 is provided to a window formed in a side wall of the vacuum chamber 1. A photo-diode 15 for detecting plasma light intensity within the vacuum chamber 1 through the optical filter 14 is also provided in the side wall.

When etching, while a predetermined amount of processing gas is supplied into the vacuum chamber 1 by the gas supply system 2, the vacuum chamber 1 is evacuated by the vacuum pump 3 so as to adjust the pressure inside the vacuum chamber 1 to a predetermined level. RF power is applied to the lower electrode 5 from the RF power source 4, whereupon plasma is generated in the vacuum chamber 1 and the substrate 6 on the lower electrode 5 is etched. The intensity of plasma light

at this time is detected by the photo-diode 15 through the optical filter 14, which passes light having a predetermined wavelength, to monitor the etching process.

During etching, a processing gas is supplied at a predetermined flow rate into the vacuum chamber 1, while the vacuum chamber 1 is evacuated to adjust the pressure therein. RF power is applied to the lower electrode 5 from the RF power source 4, for generating plasma in the vacuum chamber 1 to etch the substrate 6 on the lower electrode 5.

The substrate 6 has a plurality of stacked layers including metal layers and a base of glass. The etching process is monitored by detecting plasma light intensity with the photo-diode 15 using the optical filter 14 for passing light.  $\text{CHF}_3$  is added to the processing gas for etching the lowermost layer on the substrate.

Fig. 2 shows the profile of plasma light intensity with respect to the etching process time observed in this example.  $\text{CHF}_3$  gas was added in a proportion of 10% with respect to the total flow rate of the processing gas during the period from G to H in Fig. 2.

### **CONCISE STATEMENT OF THE ISSUES**

Issue 1 - Whether the rejection of claims 1-3, 12, and 14 as obvious over Hori et al. in view of Chen et al. under 35 U.S.C. §103(a) is in error?

Issue 2 - Whether the rejection of claims 4 and 6 as obvious over Hori et al. in view of Chen et al. and further in view of Fong et al. under 35 U.S.C. §103(a) is in error?

Issue 3 - Whether the rejection of claims 7-11 and 17-22 as obvious over Hori et al. under 35 U.S.C. §103(a) is in error?

Issue 4 - Whether the rejection of claims 13 and 23 as obvious over Hori et al. in view of Chen et al., in view of Fong et al. and further in view of Ishigami under 35 U.S.C. §103(a) is in error?

### **GROUPING OF CLAIMS BY GROUNDS OF REJECTION**

For each ground of rejection which the Appellant contests herein which applies to more than one claim, such additional claims, to the extent separately identified and argued below, do not stand or fall together.

**SPECIFICATION OF ERRORS OF THE REJECTION  
AND APPELLANT'S ARGUMENTS**

**Issue 1 - Whether the rejection of claims 1-3, 12 and 14 as obvious over  
Hori et al. in view of Chen et al. under 35 U.S.C. §103(a) is in error?**

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

In the "Response After Final Rejection or Advisory Action" sent via facsimile to Appellant's representatives on May 9, 2003, the Examiner alleged the following:

Hori clearly suggests the desirability of the claimed invention. Applicants are directed to the various embodiments and figures where Hori teaches the claimed limitations. Please note that there are three possible sources for motivation to combine the references: the nature of the problems to be solved, the teaching of the prior art, the knowledge of persons of ordinary skill in the art. In re Rouffet 149 F.3d 1350, 1357, 47 USPQ 2d 1453, 1457-1458 (Fed. Cir. 1998). The Examiner takes the position of the combination of the references and embodiments taught every element of the claimed invention, and therefore Applicants argument is moot. Please see MPEP 2143.01 [R-1] and MPEP 2144.06, In re Kerkhoven, 626 F.2d 846, 850, 205 USPQ 1069, 1072 (CCPA 1980) (citations omitted). Also see Ex parte Quadranti, 25 USPQ2d 1071 (Bd. Pat. App. & Inter. 1992).

The Examiner's above comments followed an interview conducted on May 5, 2003 and a Final Office Action dated January 21, 2003. In the Final Office Action, the Examiner offered the following in rejecting claims 1-3, 12 and 14:

Pertaining to claim 1, see FIGS. 1-29 where Hori teaches a dry etching process including:

providing a substrate 51 having a plurality of stacked layers including metal layers and a base layer;

introducing a processing gas into a vacuum chamber to achieve a predetermined controlled pressure level therein; applying radio frequency power 24 (see FIGS. 2-9E) to a substrate 51 placed within the vacuum chamber 20 for generating plasma (not shown) in the vacuum chamber, whereby the substrate is processed, the substrate having a plurality of stacked layers including metal layers (see FIG. 9A-9F); etching the layers on the substrate with the processing gas until a time point when the surface of a lowermost layer on the substrate is etched; and

adding CHF<sub>3</sub> (column 13, line 42), gas to the processing gas for etching the lowermost layer on the substrate. However, Hori fails to disclose that a base layer of silicon dioxide is a glass. In view of Chen, it would have been obvious to one of ordinary skill in the art to

disclose that the glass layer of Chen is merely nothing more than a silicon dioxide layer in the Hori semiconductor process because a glass layer is a silicon dioxide (column 4, lines 44-45).

In both the comments provided by the examiner in the "Response After Final Office Action or Advisory Action" and the Final Office Action, the Examiner failed to establish a *prima facie* case of obviousness. First the examiner failed to provide proper motivation for developing a teaching of a reference to reject a claim. The examiner alleges that there are three possible sources of motivation to combine the references, "the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art," in the "Response After Final Rejection or Advisory Action." However, the examiner failed to provide any of the three noted sources.

The examiner misunderstood the nature of his comments. For instance, the examiner relied on Hori et al. for rejecting the feature of a processing gas of  $\text{Cl}_2$  or a gaseous mixture containing  $\text{Cl}_2$  for etching a lowermost layer on a substrate. Thus, to properly reject this feature, the Examiner must provide motivation to develop the teachings of the Hori et al. reference, rather than merely combine the Chen reference with the Hori et al. reference, for the examiner has not established relevancy in regard to the Chen reference and the feature of etching the lowermost layer with  $\text{CHF}_3$  and a processing gas of  $\text{Cl}_2$  or a gaseous mixture containing  $\text{Cl}_2$ .



In any event, merely citing an opinion of the Court of Appeals for the Federal Circuit, for example, without providing the corresponding specific teaching fails to provide motivation or suggestion to develop the teachings of Hori et al. and/or combine references. Thus, the rejection fails for lack of motivation or suggestion.

The numerous opinions cited by the examiner fail to support his position that the claimed invention is obvious. In re Rouffet, 47 USPQ2d 1453, 1458 (Fed. Cir. 1998), clearly stands for the principle that the examiner must explain the specific understanding or principle within the knowledge of the skilled artisan that would motivate one with knowledge of Hori et al.'s and Chen's invention to make the combination of the references and/or develop the teachings of Hori et al. Lack of such motivation or suggestion results in failure to establish a *prima facie* case of obviousness. Id. In the present prosecution history, the examiner failed to provide proper motivation or suggestion. Accordingly, the rejection is without basis. See Manual for Patent Examining Procedure §2143.01, quoting In re Rouffet, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457-58 (Fed. Cir. 1998) (The combination of the references taught every element of the claimed invention; however, without a motivation to combine, a rejection based on a *prima facie* case of obvious was held improper.)

In addition, the Examiner failed to establish that the etching of the lowermost layer with  $\text{Cl}_2$  or a gaseous mixture containing  $\text{Cl}_2$  was useful for the same purpose as etching other layers of the materials on the substrate. See In re Kerkhoven, 205 USPQ 1069, 1072, 1074 (C.C.P.A. 1980). In the past, use of  $\text{Cl}_2$  and  $\text{CHF}_3$  have been avoided because this combination of chemicals may cause an etch stop when used for etching an Al layer. Thus, the claimed chemical compositions and associated methodology are specifically developed to avoid problems with Al. The examiner has provided no indication that etching Al with these chemicals was a known problem. Rather, the examiner reviewed the prior art and was only able to find that these chemicals were used as etchants. The examiner failed to develop through direct teaching, motivation or suggestion that a combination of these chemicals would be desirable to use to etch the lowermost layer. The examiner failed to consider the complexity of selecting chemicals for etching a substrate with a plurality of metal layers and a base of glass. The examiner failed to provide indication, motivation or guidance from the prior art that chemical(s) used for etching one layer would or would not be beneficial in etching all layers universally without consideration to certain prior art problems, such as etch stops. Therefore, the examiner failed to provide motivation or suggestion to establish a prima facie case of obviousness.

Furthermore, the presently claimed invention results in a true practical advantage over the prior art with unexpected differences. See Ex parte Quadranti, 25 USPQ2d 1071, 1073 (Bd. Pat. App. & Inter. 1992). The use of  $\text{Cl}_2$  or a gaseous mixture containing  $\text{Cl}_2$  is advantageous in that favorable etch shapes and uniform etching rate are achieved because  $\text{Cl}_2$  has high reactivity with Al and Ti. Moreover,  $\text{Cl}_2$  or a gaseous mixture containing  $\text{Cl}_2$  has low reactivity with  $\text{SiO}_2$  and SiN that constitute underlying layers; thus, the underlying layers are hardly damaged. Secondly, the advantage of using  $\text{CHF}_3$  in combination with  $\text{Cl}_2$  or a gaseous mixture containing  $\text{Cl}_2$  when etching the lowermost layer is that it eliminates crosswise etching into the etch shape by providing a protective film on the side walls of the etch shape. Further, depending on the ratio between  $\text{Cl}_2$  and  $\text{CHF}_3$  that does not etch with Al, it is possible to etch Ti while not etching Al. Lastly, the use of  $\text{Cl}_2$  and  $\text{CHF}_3$  have been avoided because this combination may cause an etch stop when used for etching an Al layer. Accordingly, as the presently claimed invention results in a true practical advantage over the prior art with unexpected differences, the examiner has failed to establish a *prima facie* case of obviousness.

In addition, the Examiner referred Appellant to the Manual for Patent Examining Procedure (MPEP) §2143.01 and §2144.06 to support his position that the claimed invention is obvious. These sections of the MPEP are also favorable

to Appellant in showing that the examiner failed to establish a *prima facie* case of obviousness in rejecting the claims. For instance, it is well settled that a statement indicating that modifications of the prior art to meet the claimed invention would have been " 'well within the ordinary skill of the art at the time the claimed invention was made' " because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references. Manual for Patent Examining Procedure §2143.01, quoting Ex parte Levengood, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993).

The examiner's rejection also fails because there is no reasonable expectation of success that a development of the Hori et al. reference or a combination of the Hori et al. reference and the Chen et al. reference would result in an operative embodiment to properly reject claim 1, for example.

In the past, use of  $\text{Cl}_2$  and  $\text{CHF}_3$  have been avoided because this combination of chemicals may cause an etch stop when used for etching an Al layer. The present invention uses this combination only after the Al layers have been etched away. The Examiner has failed to establish a reasonable expectation of success of using the

combination of chemicals in view of the problem that an etch stop could result when etching an Al layer. The Hori reference is completely silent on the issue of using a combination of  $\text{CHF}_3$  and  $\text{Cl}_2$  or a gaseous mixture containing  $\text{Cl}_2$  to etch the lowermost layer of any substrate. In view of the known problem in the prior art, the examiner's rejection fails because he failed to provide a reasonable expectation that a combination of  $\text{CHF}_3$  and  $\text{Cl}_2$  or a gaseous mixture containing  $\text{Cl}_2$  would be advantageous for etching specific layers.

Furthermore, the examiner's rejection fails because it does not teach every element of the invention.

Independent claim 1 recites, in part:

providing a substrate having a plurality of stacked layers including metal layers and a base of glass; . . .  
adding  $\text{CHF}_3$  gas to the processing gas for etching the lowermost layer on the substrate, wherein the processing gas is one of  $\text{Cl}_2$  and a gaseous mixture containing  $\text{Cl}_2$ .

Thus, the lowermost layer on the substrate is etched with a processing gas including  $\text{Cl}_2$  or a gaseous mixture containing  $\text{Cl}_2$ . This limitation is not taught by the cited art. The Hori et al. reference is silent on the issue of etching a lowermost layer on the substrate with  $\text{Cl}_2$  or a gaseous mixture containing  $\text{Cl}_2$ . For instance, in Hori et al., examples 2, 3, 4, 9, and 10 fail to etch the lowermost layer on the substrate. In addition, examples 1, 5, 6, 11, and 12 fail to etch the lowermost layer on the substrate or fail to use  $\text{Cl}_2$  or a gaseous mixture containing  $\text{Cl}_2$  to etch

the lowermost layer on the substrate. Furthermore, the addition of the Chen et al. reference fails to teach this limitation.

The examiner has also failed to establish a prima facie case of obviousness regarding the feature of providing a substrate having . . . a base of glass.

In regard to this feature, the examiner has failed to provide proper motivation for combining the Chen reference with the Hori et al. reference. For instance, the examiner merely provided a teaching that the glass layer disclosed in Chen is silicon dioxide (column 4, lines 44-46).

In addition, there is no reasonable expectation of success that the combination of references would result in the claimed invention. The Hori et al. reference and the Chen et al. reference cannot be successfully combined to arrive at the present invention. The Examiner has failed to provide any motivation to use the glass ( $\text{SiO}_2$ ) of Chen et al. as the base layer of Hori et al. For instance, in example 4 of Hori et al., base layer 51 is Si and layer 52 is  $\text{SiO}_2$ . Thus, such a substitution of the base layer 51 of Hori et al. with the glass layer of Chen et al. would result in a single layer of  $\text{SiO}_2$  in Hori et al. Furthermore, the glass of Chen et al. is for etching (see Chen et al., column 4, lines 3-5, for example), while in the present invention, the glass is not etched.

Moreover, a request was made to the examiner to provide a teaching directed to motivation to combine the references in the event the Examiner maintained a rejection based on the combination of the Hori et al. reference and the Chen et al. reference, which he failed to do.

Accordingly, as the cited art fails to teach or suggest the claimed invention, it is respectfully requested that all rejections under 35 U.S.C. §103(a) be withdrawn.

**Issue 2 - Whether the rejection of claims 4 and 6 as obvious over Hori et al. in view of Chen et al. and further in view of Fong et al. under 35 U.S.C. §103(a) is in error?**

It is respectfully submitted that the rejection of claims 4 and 6 also fails because the examiner did not provide proper motivation to specifically reject the feature of claim 4. Appellant's representatives believe that the concept of motivation has been well established above. In addition, the rejection fails because the detection system of Fong et al. is an end point detection system which determines the endpoint of a cleaning process (column 38, lines 23-26 and 43-47) rather than determining by monitoring the etching process as presently claimed.

The rejection of claim 6 fails because of its dependency on claim 4. Accordingly, it is respectfully requested that all rejections under 35 U.S.C. §103(a) be withdrawn.

**Issue 3 - Whether the rejection of claims 7-11 and 17-22 as obvious over Hori et al. under 35 U.S.C. §103(a) is in error?**

The examiner relied on the teachings of In re Aller, Lacey and Hall, 105 USPQ 233 (C.C.P.A. 233) and In re Woodruff, 16 USPQ2d 1934 (Fed. Cir. 1990), for rejecting these claims and specifically alleged that the specification contains no disclosure of the critical nature of the claimed ranges or any unexpected results arising therefrom. Appellant respectfully disagrees with the examiner regarding the criticality of the claimed ranges. In the specification of the present application, page 6, lines 5-9, the criticality of the concentration of CHF<sub>3</sub> lower than 40% is clearly set forth. For instance, when the concentration is greater than 40%, an etch stop occurs on the substrate (specification page 6, lines 5-9). Also, the specification, page 7, lines 13-18 indicates that a concentration of CHF<sub>3</sub> of 5%-10% results in less crossetching. Avoiding an etch stop is clearly not merely furthering a principle but a decisive advantage of the present invention. See In re Woodruff at 1936; In re Aller, Lacey and Hall at 235; In re Merck & Co., 231 USPQ 375, 379-381 (Fed. Cir. 1986). Thus, Appellant respectfully submits that



the claimed ranges are critical and the examiner failed to establish a case of obviousness. Accordingly, it is respectfully requested that all rejections under 35 U.S.C. §103(a) be withdrawn.

**Issue 4 - Whether the rejection of claims 13 and 23 as obvious over Hori et al. in view of Chen et al., in view of Fong et al. and further in view of Ishigami under 35 U.S.C. §103(a) is in error?**

It is respectfully submitted that the rejection of claims 13 and 23 also fails because the examiner did not provide proper motivation to reject the claims. Appellant's representatives believe that the concept of motivation is well established above. For instance, in the rejection the examiner has failed to provide any reason to include the titanium and aluminum layers on the substrate provided in Hori et al. Rather, it appears the examiner impermissably relied on hindsight to reject these claims. Accordingly, it is respectfully requested that all rejections under 35 U.S.C. §103(a) be withdrawn.

#### **SUMMARY**

In view of the above remarks, it is respectfully submitted that the claims particularly describe and distinctly claim elements not disclosed in the cited

references. Therefore, reversal of all rejections of the claims and their allowance are respectfully requested.

### **FEE AUTHORIZATION**

Please charge the \$320.00 official Appeal Brief fee to Deposit Account No. 10-1250. Charge any fee deficiency or credit any excess payment to the same Deposit Account.